Since many of the various occupations cited as having excessive lung cancer rates sustain exposure to already recognized occupational carcinogens, such as coal tar, mineral oil, pitch, chrome pigments, arsenic, nickel, asbestos and soot, a searching study of the carcinogenic exposures underlying the observed epidemiologic differences in lung cancer rates for such occupational group would result in part in an extension of the scope of the recognized occupational cancers hazards to the respiratory organs (Hueper, 1966).

There exists moreover the distinct probability that more recently acquired information on carcinogenic properties of chemicals used or produced in the human economy might establish similar occupational relations for members of additional groups with excessive lung cancer rates. Several experimental observations, for instance have shown that overheated fats and oils, such as those resulting from deep fat frying procedures, induce cancers in rodents upon parenteral, i.e. usually subcutaneous introduction and that they contain carcinogenic polycyclic aromatic hydrocarbons, such as 3,4-benzpyrene (Borneff, and Fabian; Beck; Peacock; Saruta and Oki; Steiner, Steele and Koch). In fact, Schiffmann has incriminated exposure to pyrolyzed fat inhaled for occupational reasons for the development of a carcinoma of the vocal cord. Since adequate epidemiologic evidence exists showing that pulmonary carcinogens have induced in man under occupational conditions of exposure also cancers in the nasal sinuses and larynx (nickel, chromium, arsenic, mineral oil, coal tar) (Hueper, 1966), such occupational contacts may account for the high lung cancer rate observed among commercial cooks by Breslow.

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Formaldehyde, a mutagenic chemical, extensively usdd in industry as a preservative, fumigant, hardening agent of photographic films, water-proofing, wrinkle-proofing and crease proofing of textiles, and for the impregnation of wall boards, and the production of several plastics and medical preparations (Henson; Quinn and Kennedy; Auerbach), has produced when inhaled by or introduced into the lungs of rodents metaplastic proliferations of the bronchial mucosa (Garschin and Schabad; Otto) and when subcutaneous injected sarcomas in rats (Watanabe and Sugimoto; Watanabe, Matsunaga, Soejima, and Iwata). A carcinogenic action of formaldehyde vapors on the human lung of workers following different trades is a distinct possibility.

Similar considerations must be extended to workers imhaling dusts and fumes of various carcinogenic chlorinated hydrocarbon pesticides, such as DDT and Dieldrin (Hueper, 1966; Kemeny and Tarian; Randig).

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The same considerations apply to workers producing, processing or handling various hydrazine compounds, used as herbicides, rocket propellants, and tuberculostatic medicinal agents (maleic hydrazine, isonicotinic acid hydrazine), since isonicotinic acid hydrazine has proven to be a potent carcinogen for the lung of mice in the hands of many investigators (Juhasz, Balo and Szende; Bianciftori and Severi; Schwan; Severi and Bianciftori; Pansa, Picco and Gnavi) after oral administration. Since isoniacid is being given prophylactically to persons exposed occupationally to tubercle bacilli, this problem is of more than purely medicinal interest, although Hammond, Selikoff and Robitzek were unable to demonstrate any excessive lung cancer liability in tuberculous patients given isoniacid for therapeutic reasons. The once contemplated use of 4-nitroquinoline-1-oxide as a fungicide and the growing production of various nitrosamine in industry also may lead to the discovery of worker groups with so far not recognized occupational cancer hazards to the lung and nasal sinuses

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

(Hammond,Selikoff amd Robitzek;Pansa,Picoo and Gnavi)(Dontenwill and Mohr; Druckrey,Ivankovic,Mennel and Preussmann;Mori,Kondo and Susuki;Mori;Thomas and Schmaehl;Angus and Hoch-Ligeti). Since several carbamate derivative are widely used as herbicides (isopropyl-N-phenylcarbamate) and insecticides (1-naphthyl-N-methylcarbamate), while ethyl carbamate has been employed as an anesthetic of fishes, it should be mentioned that the latter chemical is a potent carcinogen capable of inducing cancers of various organs in several species of rodents and has been incriminated by Bald of having caused cancers of the lung in man when given as an ingredient in medical preparations (Tannenbaum and Silverstone;Balo,Juhasz and Kendrey;Toth,Tomatis and Shubik; van Esch,van Genderen and Vink;Klein;Schoental and Magee;Wood).An occupational lung cancer hazards after cutaneous,oral or respiratory contact in man for occupational reasons must be considered a distinct possibility.

It is not surprising that attempts have been made for attributing the reported occupational variations in lung cancer rates of different socioeconomic classes and occupational groups to variations in their cigarette smoking habits as the totally or partially responsible factor(Haenszel,Shimkin and Miller;Haenszel and Skimkin;Buell,Dunn,and Breslow). Haenszel et al. thus demonstrated some differences in current cigarette use between broad occupational groups.The proportion of cigarette smokers increased somewhat w with lower social class,though heavy smoking did not increase the same way. Being protagonists of the cigarette theory they proposed that part or all of the social class variations in lung cancer mortality might be due to these smoking differences(Buell,Dunn and Breslow).They argued that some occupations might actually favor heavy smoking,while others might restrict opportunity for smoking;that laborers belonging to social class V might leave much smaller cigarette butts than managers of class II. In final conclusion Buell et al. felt that more research into the environmental causes and conditions of exposure is needed for arriving at more definite conclusions as to the primary reasons for the differences in lung cancer rates among members of various social classes and occupational groups.

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

3. Occupational Cancers

The real and important significance of the evidence regarding the association of general atmospheric pollution and of membership in certain socioeconomic classes and in various trades and profession to an excessive liability to lung cancer receives convincing support from the substantial amount of data relating definitely an appreciable number of well defined occupational agents to the high lung cancer rates demonstrated in circumscribed occupational groups. The actual existence of cause and effect relationships between these occupational respiratory carcinogens and the development of cancer of the lung, larynx and nasal sinuses is based on reliable epidemiologic and clinical observations, pathologic findings and, in many instances, on a positive production of cancers of the lung and of other organs in animals exposed through various routes to the specific carcinogens. The information obtained through such studies has provided moreover confirmatory evidence indicating that there exist chemicals which exert their carcinogenic action on the lungs not only when inhaled but also when introduced through the oral route (arsenicals, nitrosamines, carbamates, 4-nitroquinoline-N-oxide, benzidine, isoniacid) (Hueper, 1966) 1965). Because of the identity of the general atmospheric pollutants of incriminated nature with those found to be potent respiratory carcinogens under specific occupational conditions, definite proof has been obtained not only as to the presence of recognized and identified carcinogens in urban air, but also concerning the high carcinogenic potency of several of these carcinogens. Their action under occupational conditions of exposure surpasses greatly that exerted presumably by a combined action of all carcinogens present in cigarette smoke. Occupational carcinogens of such a potency are radioactive chemicals, arsenicals, chromates, asbestos, coal tar fumes, and nickel.

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

The validity of this statement is amply illustrated by observations made during the last decade in regard to the lung cancer attack rates recorded for individuals who had occupational contact with some of these carcinogens.

Radioactive chemicals: It had been known for many years that miners of radioactive ores in Saxony and Bohemia had highly excessive lung cancer death rates amounting to about 70 % of all deaths among the Schneeberg miners and about 40 % of those among the Joachimsthal miners. The recent observations on the occurrence of radiation-cancers of the lung among radioactive fluorspar miners in Newfoundland, Canada (de Villiers and Windish; Parsons, de Villiers, Bartlett, and Becklake) as well as among uranium ore miners in Colorado (Wagoner, Archer, Carroll, Holaday and Lawrence; Wagoner, Archer, Lundin, Holaday and Lloyd) have again demonstrated the distinct lung cancer hazards connected with such work. A recent estimate of the prospective number of lung cancer victim among the approximately 6,000 uranium ore miners employed in Rocky Mountain mines cites over 1,000 candidates for death from lung cancer regardless whether they continue or discontinue their hazardous work. The tragic aspect of this development is the fact that a timely introduction of preventive technologic measures could have prevented a good part of this death toll (Hueper, 1965, 1966). It is therefore noteworthy that information on the existence of lung cancer hazards for such miners is missing from several countries where such operations have been carried on for a sufficient number of years (Canada, South Africa, U.S.S.R., Congo).

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Asbestos: A similar situation has appeared during the last decade in connection with the lung cancer hazards associated with the inhalation of asbestos dust not only by the large number of asbestos workers employed by a rapidly growing industry (Hueper, 1965) but also by residents of the neighborhood of asbestos plants and of the general public exposed to asbestos abrasions from automobile brake linings (Conference on Biological Effects of Asbestos, 1964)

Table 38

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Selikoff recently estimated that one death out of five in asbestos insulation workers in metropolitan New York was [illegible] by cancer of the lung. This revelation comes after many years of denial by manufacturers of asbestos goods in the United States that such hazards exist among their employees and following the publication of an industry-sponsored survey allegedly showing their non-existence in Canadian asbestos miners(Braun and Truan). Observations reported from South Africa, England, Scotland, Germany, U.S.A. and Canada indicate moreover that an ordinarily rare type of cancer involving the pleura and peritoneum, known as mesothelioma, has affected persons with occupational and environmental contact with asbestos (Cuthbert; ; Wagner, 1967; Dem; Newhouse and Thompson; Hueper, 1966). While such mesotheliomas are causing death in one out of 10,000 population, they were responsible in New York for one out of 10 deaths among asbestos workers(Selikoff). An increased lung cancer rate was recorded for Canadian asbestos product workers by Enterline.

Chromates: Producers of chromates are suffering from an excessive liability to lung cancer according to observations reported from Germany, England, U.S.A., Italy, Czechoslovakia. Almost 200 cases of lung cancer in chromate workers have been placed on record, obviously representing only an undetermined fraction of the actual number of cases, since no attempt has been made so farrto extend epidemiologic studies to other occupational groups also exposed to chromium and chromium compounds, such as especially chromium pigments extensively used in anticorrosive paints in various large metal and metal product industries(ship building, aviation, railroad cars, bridge construction, pipe lines, etc.). In a report by Gafafer et al. it was noted that in one American chromate plant white workers had a morbidity lung cancer rate of 40 times the standard rate, while the more intensely exposed colored workers had a rate which was 80 times the standard rate. Table 39

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Table 38

TABLE 35.—*Causes of Death Among Male Asbestos Workers Compared with the Mortality Experience of All Men in England and Wales (Doll)*

Cause of Death	No. of Deaths		Significance of Difference Between Observed and Expected (Value of *P*)
	No. Observed	Expected on England & Wales Rates	
Lung cancer *	11	0.8	<0.000001
Other respiratory diseases † and cardiovascular diseases:			
With mention of asbestosis	14	--	<0.001
Without mention of asbestosis	6	7.6	
Neoplasms, other than lung cancer	4	2.3	>0.1
All other diseases ‡	4	4.7	
All causes	39	15.4	<0.000001

* Including 1 case with pulmonary tuberculosis.
† Including pulmonary tuberculosis.
‡ Including 2 cases (benign stricture of esophagus and septicemia) in which asbestosis was present but was not thought to have been a contributory cause of death.

Table 39

TABLE 34.—*Lung Cancer Rates in Chromate Workers (W. C. Hueper)*

Country	Expected	Frequency Observed	Frequency Rate per 100,000	
			Chromate Workers	General Population
United States	1.9	31.9	470.8	16.7
Germany	1.0	43.0		
England	1.3	7.0		

Table 40

TABLE 33.—*Observed and Expected Number of Cancers of the Lung, Nasal Cavity, and Paranasal Sinuses in English Nickel Workers (Doll)*

Period	Organ	No. of Cancers		Ratio Between Expected and Observed No. of Cancers
		Expected	Observed	
1938-1947	Lung	2.6	36	1:13.8
1948-1956		5.9	39	1: 6.7
1938-1947	Nasal cavity and sinuses	0.066	16	1:242
1948-1956		0.082	13	1:159

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Arsenic: While arsenic has been suspected for many decades as a cause of lung cancer after occupational, dietary and medicinal exposures, the recent epidemic of arsenic cancers involving various organs (skin, liver, lung, etc.) which developed among Germany vineyard workers following their use of arsenical pesticides in the vineyards and the consumption of wine contaminated with their residues, has definitely demonstrated that arsenic is a pulmonary carcinogen even after oral introduction (Gross) 1967). Among 81 cases of chronic arsenic poisoning of this source who came to autopsy, 44 had cancer of the respiratory system (lung, nasal sinuses, larynx) (Roth, 1959). Several of these lung cancers affected individuals who were non-smokers. The increased lung cancer mortality rates found by Wagoner et al. among American metal ore miners in the Rocky Mountains and the reported excessive incidence of lung cancers among copper ore miners and smelter workers in Montana where arsenic containing copper ores are processed provide observations which should stimulate epidemiologic studies of greatly extended scale among miners and smelter workers also in Canada. Table 44

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Nickel: Cancers of the lung and nasal sinuses first described in 1933 by Stephens as occurring among nickel refinery workers at Clydach, Wales, have subsequently been seen also in nickel workers of other countries, such as Norway, Canada, U.S.S.R. Doll's more recent surveys fixed the lung cancer rate of these workers at about 13 times the standard rate between 1938 and 1947 and as about 6 times between 1948 and 1956. The ratio of observed to expected cancers of the nasal cavity and nasal sinuses among them stood at 196 : 1 during the period of 1938-1956. It is of interest that 3 of the Russian victims (2 nasal sinus cancers, 1 lung cancer) were employed in a nickel electrolysis plant (Tatarskaya). According to Doll a total of 131 lung cancers and of 61 nasal cancers were observed at Clydach between 1923 and 1958. Table 40

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Iron: The discovery by Faulds and Stewart of the elevated lung cancer rate among English hematite miners, by Dunner and Hicks of similar conditions among boiler scalers exposed to iron dust (Harding and Massie), by French investigators (Braun, et al.; Monlibert et al.) of such conditions among iron ore miners in Lorraine have created the suspicion that such exposures might favor the development of lung cancers in workers inhaling iron oxide dust. Sutherland proposed that members of these worker groups are heavy cigarette smokers which accounts for the reported observations, in his opinion. Since increased lung cancer rates were noted also among iron ore miners of the Messabie range in Minnesota, there is nevertheless adequate justification for keeping all workers inhaling iron dust under close medical surveillance as a precautionary measures, so as to establish the fact whether such exposures do or do not play a causal role in the induction of lung cancers. Table 40

Beryllium: The growing use of beryllium and its compounds in the modern industrial economy and the reported development of berylliosis, a special granulomatous progressive condition of the lung, in beryllium workers also requires distinct alertness toward a possible existence of an occupational lung cancer hazard. While so far only about half a dozen cases of a combination of berylliosis and lung cancer have been reported, experimental work of Vorwald and of Schepers have shown that rats and monkeys inhaling beryllium oxide develop multifocal carcinomas of the lung.

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Mustard Gas: Soon after World War I the observations of lung and larynx cancers among veterans who had sustained war gas poisoning aroused the suspicion of the existence of causal relations between these two events. The recent demonstration of such cancers in significant number among Japanese mustard gas workers confirmed this suspicion (Wada and Watanabe; Yamada et al.).

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Similar observations have been made in Germany, according to Badder, among mustard gas ammunition workers exposed during World War II. Whether or not American war gas producers and ammunition workers were also affected by such cancers after the War is uncertain, although over one thousand cases of gas poisoning occurred in one arsenal. Respiratory cancers represented 16 % of all deaths among Japanese war gas workers compared with an 0.5 % normal rate.

Isopropyl Oil: This material is the crude liquor from which isopropyl alcohol is distilled. Cancers of the lung, nasal sinuses and larynx were seen among production workers in two separate operations. While the number of observed cases is small, the high incidence of nasal sinus cancers in this group of workers provided practically conclusive evidence concerning the existence of a specific occupational respiratory cancer hazard(22 times normal rate).

Coal Tar, Pitch, Soot: An abnormally high frequency of lung cancer among workers exposed to the inhalation of coal tar fumes and dusts has been noted in Japan, England, Norway, , U.S.A. and Canada(Doll; Bruusgard; Kennaway and Kennaway; Kawahata and Kuroda; Kawai, Matsuyama and Amamoto; Christian). The occupational group thus affected were mainly coke oven and generator gas retort workers in steel plants and gashouses. It is likely that identical hazards exist for many other types of workers having the same type of exposure, such as makers of pitch impregnated paper pulp conduits, water proofers of buildings and walls, makers of dry battery boxes, electric appliances, electrometallurgical carbons, commercial carbon blacks, coal tar paved roads, roofing tar paper, metal castings etc, (Sawicki; Hueper; MacKenzie; McLaughlin; Kimina; Maly and Mader). Patch; So far a total of 227 such cases have been published, which are a small fraction of the actual ones, considering the amount of unpublished information on this subject and the widespread lack of epidemiologic surveys. The mortality rates ranged between a minimum of 149 to a maximum of 784, with a standard rate of 100.

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Although firemen are exposed frequently to the inhalation of smoke from the incomplete combustion of carbonaceous materials and to fumes, vapors and gases of noxious nature, mortality surveys of city firemen of New York City and of Toronto by Saland and SSeley and by Mastromatteo did not reveal any abnormalities in their lung cancer death rates. In view of similarly negative initial reports on a noncarcinogenic pulmonary effect of occupational exposures to established respiratory carcinogens, a comprehensive reexamination of this issue might be indicated before any definite conclusions be drawn. Such measures are indicated likewise for the numerous additional industrial operations in which workers become exposed to coal tar and pitch or soot, such as, for instance, rubber manufacturing plants, steel works, gas plants, public power plants and similar establishments.

2015031733

Petroleum, Shale Oil, Asphalt: Numerous chemical analyses and bioassays of petroleum products performed on experimental animals attest to the fact that these products as well as their thermic distillation and combustion products contain carcinogenic hydrocarbons and induce cancers, respectively (Hueper; Hueper and Conway). It stands to reason therefore that the inhalation of such products should represent a lung cancer hazard in analogy to such an effect associated with other established carcinogenic chemicals when inhaled. Opportunities for such an action by petroleum distillation and combustion products exist for workers employed in oil refineries and cracking plants, oil shale and asphalt retorting operations, steel plants and foundries, textile and metallurgical plants, service stations, garages, diesel motor test operations, electrometallurgical factories, diesel locomotive haulage, electric power substations using oil current breakers, and many other industrial establishments (Gilman and Vesselinovich; Mastromattee; Kuratsune and Kohchi; Hueper; Calbiani; Crook; Katz; Waller, Commins and Lawther; Jones; Kling, Samssonow and Heros; Roesch; Baldwin and Cunningham; Baldwin, C and Pratt; Rondia; Poel; Eckhardt; Zdrazil and Picha;

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Kotin et al.;Falk et al.;Horton et al.;Page et al.;and many others). Exposure to mineral oil in the air of factories,hospitals and homes can be associated with the use of mineral oil filters in the air conditioning equipment. Such oils may contain a considerable amount of 3,4-benzpyrene(Hecht)Bushman and Clark;Hueper). Such respiratory exposures to oil mists and fogs may also accompany the use of pesticide preparations having andoil base(Poel). Finely dispersed oil can be introduced into the air conditioning ducts also from the emission of rotary pressess in printing shops. Mineral oil may become attached to asbestos dust when dispersed from spinning machines in asbestos textile plants,or may enter the atmosphere of foundries,automatic glass factories in the form of fumes. Both lubricating oil mist and gasoline fogs are expelled with the automobile exhaust of gasoline engines and thus may contaminate the air of garages and automobile repair stations.

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In contrast to the abundant evidence concerning the content of marious widely used petroleum products with carcinogenic properties in the human economy and despite the proven numerous opportunities of members of large worker groups as well as of the general public to inhale mists and fumes of carcinogenic petroleum distillates and fractionation products and their various combustion products ,there exists astonishingly little published information on the development of lung cancers among such parties after occupational and environmental contacts. Excessive lung cancer rates have been observed among operatives of an oil refinery located in the West,and a similar observation has been made among men employed in a paraffin pressing operation of an oil refinery in the East of U.S.A.Huguenin,Fauvet and Bourdin discovered unusually often lung cancers among workers with occupational contact with lubricating and cooling oils(turners,millers, mechanics,,planers,and fitters)who worked in an oil fog . Of 112 lung cancer patients 32 belonged to this group. The observation of Turner and Grace regarding the occurrence of lung cancers among workers in metal industries

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Table 41

TABLE 33.—*Siderosis of Lung and Cancer of Lung in English Hematite Miners and Iron Foundry Workers*

Author	Occupation	No. of Autopsies	No. of Lung Cancers	Percentage
McLaughlin and Harding	Iron foundry workers	149	16	10.8
Faulds and Stewart	Hematite miners	180	17	9.4
Harding and Massie	Boiler scalers	12	3	20.0
Faulds and Stewart	Controls	2,220 (over 30 years))	45	2.0

Table 42

Table 13. Frequency of lung cancer among operating and nonoperating railroad workers

Railroad	Period	Total lung cancers	Type of railroad worker					
			Operating		Nonoperating		Undetermined	
			Number	Percent	Number	Percent	Number	Percent
A	1940–50	29	24	83	5	17	----	----
B	1939–49	104	59	57	15	14	30	29

Table 44

Lung Cancer Mortality in Several Counties of Montana, 1947-1948. (Lull and Wallach)

County and Total Population 1940	Major Industry	Number Lung Cancers		Total	Total Cancer Deaths	% Lung Cancer		Annual Lung Cancer Death Rate/100,000	
		Male	Female			Male	Female	Male	Female
Deer Lodge 13,627	Copper Smelting	21	0	21	98	30.8	0.0	145.7	0
Silver Bow 53,207	Copper Mining	27	2	29	259	22.6	1.5	48.6	3.9
Cascade 41,499	Copper Mining Smelting	20	5	25	299	12.7	3.5	46.3	12.3
Gallatin 18,269	Agriculture	1	0	1	81	3.0	0.0	5.2	0

The estimated crude death rate for lung cancer among white males in the entire United States in 1947 is 10.9 per 100,000 population.

The workers employed in copper ore minning and smelting inhale dust and fumes of arsenic contained in the ore and released as a by- and wasteproduct during the smelting process.

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Table 42

INCIDENCE OF DEATHS FROM LUNG CANCER FROM THE INSURANCE RECORDS OF THE BROTHERHOOD OF RAILROAD TRAINMEN COMPARING YEARLY INCREASE FROM 1932 TO 1952.

DEATHS FROM LUNG CANCER

Year	Deaths From Lung Cancer (per 100,000) Average age at Death 46	Year	Deaths From Lung Cancer (per 100,000) Average age at Death 46	Increase Deaths From Lung Cancer (per 100,000) Comparing 10 year Period
1932	7	1942	29	22
1933	10	1943	28	18
1934	7	1944	19	12
1935	12	1945	32	20
1936	22	1946	51	29
1937	17	1947	37	20
1938	24	1948	55	31
1939	23	1949	63	40
1940	8	1950	62	54
1941	25	1951	75	50
Total	155	Total	451	296

Increase Lung Cancer Comparing 1932 to 1941	72%	Increase Lung Cancer Comparing 1942 to 1951	158.62%
Average Increase of Lung Cancer for 10 Years 1932 to 1941	45.16%	Average Increase of Lung Cancer for 10 Years 1942 to 1951	71.38%

February 15, 1954 E. S. Ross, M. D., Chief Medical Director, Brotherhood of Railroad Trainmen.

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

(metal grinders and polishers) who inhale in addition to metal dust also mist of lubricating and cooling oils belong to the same category. So do the already mentioned findings of Berndt and of Tsuchiya and most likely also those of Christian regarding an excessive lung cancer rate among substation operators(433 per 100,000),of chauffeurs (238 per 100,000) amd mechanics (215,000 per 100,000) ,while the average rate of the nonexposed employees was 35 per 100,000.

Medical directors of two large American railroad companies reported the occur ence of an excessive number of lung cancer among the operating railroad workers(Hueper). While subsequent studies of Kaplan performed on employees of another eastern railroad apparently could not confirm the positive observation incriminating exposure to fumes from diesel locomotives in this matter,both the evidence as wellas the conclusions noted by Kaplan are open to serious doubt because of faulty controls and a distinct selective bias by using only members of a benevolent society in his investigation,even if Battigelli defends these conclusions on the basis of rather unrealistic chemical results obtained on a Baldwin diesel locomotive. Tables 41 and 42

Although substantial circumstantial evidence points to the existence of widespread and serious lung cancer hazards related to the occupational and environmental inhalation of petroleum products and their combustion products,the various governmental public health agencies,the oil companies,and the automobile industry have been in the past distinctly reluctant to undertake competent and impartial epidemiologic surveys on suitable population groups for obtaining conclusive evidence on this important and serious public health cancer problem.

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Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

The actual existence of specific occupational cancers of the respiratory organs is accepted by many environmental cancer experts, industrial physicians and public health officials throughout the world (Hueper, 1966; 1942; Baader, 1937; Doll; Bauer; Gross; Goldblatt and Goldblatt; Koelsch; Chiurco; Vorwald). This scientific acceptance has resulted in the legal recognition of many or all of the listed chemical pulmonary carcinogens as occupational carcinogens capable of inducing pulmonary cancers which have been included under the provisions of workmen's compensation laws. Considering the highly defective epidemiologic evidence on the occurrence of these cancers and their practically certain existence in much larger worker groups and in many more and diverse industries and occupations than those so far recorded, there can be small doubt that occupational cancers of the lung are much more frequent than indicated by the so far published information. The frequent allegation that occupational lung cancers involve only small segments of the total population and that for this reason occupational carcinogens can be held responsible for only a small part of the alarming frequency of lung cancers distorts the facts available and thus is misleading (Vorwald; Doll; Hammond; Wynder; Clemmesen; Pell and Fleming; Saita). Doll in a recent publication has admitted that the history of industrial lung cancer has shown that a specific industrial hazard may be overlooked for many years by both management and employees. This is indeed a rather common experience which has its cause not only in professional ignorance, but also in negligence and procrastination, as evident from a critical examination of the record (Hueper, 1966; Hueper and Conway, 1965).

2015031738

Occupational Cancer and Cigarette Smoking

Because of the obvious distinct signficance of the existence of non-tobacco factors as causes of lung cancer demonstrated by the evidence provided through occupational lung cancers, it was to be expected that some efforts would be made to minimize or eliminate, if possible, their role in

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

the controversial problem of lung cancer etiology. The most direct and simplest approach to this goal was chosen by Watson who declared that an occupational relation to primary cancer of the lung is difficult to prove, and efforts along this line have for the most part been unsuccessful. He considered as the sole exception to this rule the pulmonary cancers occurring among the radioactive ore miners in Schneeberg and Joachimsthal. Although even here he had some misgivings because of the fact that close inbreeding and heredity had not been exonerated as possible factors. After having disposed thus of the established occupational pulmonary carcinogens, Watson then proceeded to incriminate cigarette smoking as a direct or contributory or additive factor.

2015031739

Oettel recently alleged that lung cancers in chromate workers were found only in those individuals who smoked cigarettes and that this factor actually supplied the carcinogenic mechanism. Hammond at one time also considered such a possibility. Bidstrup and Case came to the following conclusion in this matter: "Thus even if the smoking habits of the chromate workers were so changed from those of the general population that all of them fell into the category of heavy smokers, the increase of carcinoma of the lung that then would be expected would not satisfactorily account for the increase which we have observed. In fact, we have no reason to believe that their smoking habits are different from those of the general population, and an explanation based on a hypothesis of altered smoking habits would need to be supported by satisfactory evidence of such alteration before it could be seriously considered". Fisher and Riekert mentioned the fact that several of the workers seen in Baltimore, Md. who had lung cancer due to their employment in a chromate factory were non-smokers. Alwens also noted in one of the early German publications of chromate lung cancers that an abuse of tobacco could not be demonstrated in most of his patients.

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

Gafafer et al. who made a broad analysis of the health hazards existing in chromate producing plants in U.S.A. mentioned that 81.1% of the chromate workers with lung cancer were smokers and that 79.4 % of foundry workers used as controls indulged in this habit. Apart from this statistical evidence refuting the claims of a cigarette etiology of occupational chromate cancers of lung, the distribution of the histological types of these cancers militates against such claims. Of 123 chromate cancers histologically examined, 46 were squamous cell carcinomas, 66 were round or anaplastic cell carcinomas and 11 were adenocarcinomas, which are claimed not to be caused by cigarette smoking. Since adenocarcinomas, in addition to squamous cell carcinomas have been produced in the lungs of rats after an intrapleural introduction of various chromates and considering the fact that these tumors developed without any intervention of cigarette smoking, the claim that chromate cancers of the lung are actually cigarette cancers is ludricous (Hueper, 1966).

In discussing the epidemiologic characteristics of occupational arsenic cancers of the lung in German vineyard workers Gross menioned the fact that several of these individuals had been non-smokers. This observation needs emphasis because it demonstrates that environmental exposures to arsenicals from other sources than cigarette smoke, i.e. pesticide residues in foods, arsenic in polluted air, arsenical medication, etc. may induce the development of lung cancers.

2015031740

Selikoff, Churg and Hammond commenting on the excessive liability of asbestos cement workers to develop lung cancer came to the following conclusion: From this we may conclude, that even if all our asbestos workers had smoked a pack or more of cigarettes a day (and, indeed, from our sample we know they did not), and if exposure to asbestos were of no significance, then their lung cancer rate would have been about 3.4 times as high as the rate of the general US male population. Clearly, the smoking habits of the asbestos

Source: https://www.industrydocuments.ucsf.edu/docs/mzyk0000

workers cannot account for the fact that their lung cancer death rate was 6.8 times ass high as that of white males in the general population". The histologic types of lung cancers seen in asbestos workers also deviate from the usual pattern claimed for a cigarette causation of lung cancers since 18 per cent of 45 asbestos cancers analyzed were adenocarcinomas (Hueper,1966). Such a causal origin is moreover totally inconceivable because of the occurrence of mesotheliomas of the pleura and peritoneum in asbestos workers all over the globe. Any speculation that asbestos is not the carcinogenic agent responsible for these tumors but carcinogenic matter attached to the dust particles and originating from inhaled cigarette smoke lacks adequate factual support(Hammond).

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Wagoner et al. commenting on the radioactive cause of lung cancer among uranium ore miners of the Colorado Plateau and Parsons et al. analyzing the significance of exposure to radioactive matter in the air of a fluorspar mine in Newfoundland were emphatic after due statistical evaluation of the evidence on the point that cigarette smoking of the miners could not account for the high lung cancer rate among these workers. Investigators sponsored by the U.S.Public Health Service as wellaas its Surgeon General have repeatedly stated that the causation of these cancers among the American miners might be attributable in toto or in part to their habit of cigarette smoking. In support of such an unwarranted speculation it was pointed out that the mucosa of dead uranium miners had shown metaplastic lesions identical with those seen in cigarette smokers(Auerbach) and that the carcinomas were of the squamous cell type,which according to the supporters of the cigarette theory indicated a causation by cigarette smoke. Apart from the fact that according to the published record the role of the Public Health Service in undertaking a study of these occupational cancer hazards has been rather notorious(Hueper,1966,1967),this latest attempt at shifting the responsibility for the causation of the lung cancers

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on the miners themselves and away from the private industry and the Atomic Energy Commission, by blaming their cigarette smoking habit for their calamity, lacks professional discretion as well as human compassion. This explanation is not only opposed by the investigators of the U.S. Public Health Service who worked on the problem for many years, but appears ludricous because some 200 Schneeberg miners succumbed to lung cancer between 1869 and 1900, i.e. during a period in which cigarette smoking was at best a negligible, if not absent, environmental factor. It is remarkable also in this connection that practically all carcinomas examined histologically by Schmorl (1928) were either squamous cell carcinomas or round cell carcinomas and had been of these types since their first discovery when they were thought of being of sarcomatous nature, in 1879 by Haerting and Hesse (Hueper, 1942). The wishful suggestion of the Surgeon General that the carcinogenic factors present in cigarette smoke seemed to exert an accentuating effect upon the carcinogenic radioactive occupational agents to which the miners become exposed is of most dubious scientific value, since it is well known from experimental studies of various exogenous carcinogens that several different carcinogens operating at the same time may not have a syncarcinogenic effect, but sometimes exert upon each other an anticarcinogenic effect or do not influence their individual action (Hueper and Conway, 1966).

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A candid analysis of this situation may assist in future compensation suits by victims of occupational lung cancers, since it has become quite customary for defense attorneys to recite in such litigations the smoking record of the claimants in an attempt to minimize as much as possible the role of the occupational factor. They have in support of these efforts as a rule the expert testimony of some medical witnesses who are adherents of the cigarette theory. It has occurred in such proceedings that the medical expert testifying for the defense would assert that 99 per cent of all lung cancers in males are due to cigarette smoking and that therefore the claimant who was exposed for some 15 years to fumes of hot pitch applied to walls in closed rooms for water proofing did not sustain

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an effective occupational exposure to a highly potent respiratory carcinogen. From this and many similar experiences in compensation medicine it appears that some of the protagonists of the cigarette theory have been guilty of their testimony and policies of injudicous judgement.

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III. Tobacco and Cigarette Smoking

The increasing habit of cigarette smoking was one of the factors which was incriminated by several investigators, especially Lickint, during the early part of the 1920s, i.e. soon after the first evidence of a growing rise in the frequency of lung cancer was discovered in Central Europe, together with other environmental agents and influences which had undergone during the preceding 20 to 30 years similar changes (tar paved road, automobile traffic, industrial air pollution, chest x-ray examinations, influenza epidemic, etc.) (Hueper, 1926). Decisions made at that time concerning the relative significancer of anyone of these factors by the different investigators was mainly based on personal impressions, since systematic statistical-epidemiologic studies were lacking and evidence on the carcinogenic action of specific chemical agents in the induction of human lung cancers of occupational origin was still some 10 to 15 years away (Hueper, 1942). The first paper in which a causal relation between cigarette smoking and lung cancer was claimed on the basis of limited statistical evidence appeared in 1939 (Mueller). It was not until the rediscovery of this association around 1950 by several American investigators, followed by others in Europe and finally throughout the world, that the theory of cigarette smoking as the chief cause of lung cancers and the principal reason for their phenomenal increase in frequency especially among males brought about wide spread acceptance of this concept which subsequently led to the development of the cigarette disease complex wherein cigarette smoking was linked to many additional and diverse diseases of cancerous and noncancerous nature, to shortening of life span, to frequency of absenteeism, and overall morbidity.

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Through open-handed financial support reinforced by an extraordinary publicity campaign by governmental and private organizations an unprecedented fervor of investigative activity was fabricated, especially during the past 10 years so as to to have this theory generally accepted as a fact thru the impact of such means of modern promotion on an ill-informed general public and thru the pressure exerted on non-conformists by skillfull public relations experts. The U.S. Public Health Service Report dealing with these efforts expressed the results obtained in the following bare figures; "Stimulated to a great extent by the 1964 report to the Surgeon General, more than 2000 research studies have been completed and reported in the biomedical literature throughout the world in the intervening three and one-half years. This compares with the total of about 3000 studies reported in all the years prior to 1964." One does not go wrong by noting that the bulk of the 3000 publications appearing during the 12 years before 1964 were the result of the rapidly increasing investigative activities on the effects of cigarette smoking on human health including particularly the causation of lung cancer carried on after 1950 when this avalanche started to descend upon the medical profession and the general public.

The medical evidence developed through this massive attack in favor of the theory that cigarette smoking is the predominant cause of lung cancer can be summarized as follows:

1. There is statistically an excessive percentage of cigarette smokers among individuals having lung cancer.

2. This excessive liability increases with the number of cigarettes smoked daily and with the duration of the habit as calculated from statistical data.

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3. These statistical associations prevail mainly for males and are only recently also demonstrable for females where they are attributed to an increase of the cigarette smoking habit in females during recent decades.

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4. The positive statistical correlation was demonstrable to a higher degree among cigarette smokers who inhaled than among those who did not inhale.

5. Chemical analyses of the cigarette smoke have shown the presence of chemicals known to be carcinogenic to man and/or animals and condensates of cigarette smoke applied to the skin or subcutaneous tissue or bronchial mucosa of experimental animals(rodents,dogs) has been followed by the development of precancerous and cancerous lesions in these tissues.

6. The cessation of cigarette smoking resulted after an elapse of one year or more in a statistically demonstrable reduction in their liability to develop lung cancer.

7. Cigarette smokers reveal a statistically significant excess of metaplastic precancerous lesions in the bronchial mucosa compared with that seen in non-smokers and develop squamous cell or round cell carcinomas only,but not adenocarcinomas. Squamous cell carcinomas and round cell carcinomas are therefore indicative of a cigarette smoke origin of lung cancers.

These are the principal criteria advanced in support of the cigarette theory by a large host of investigators(Graham and Wynder;Wynder and Hoffmann;Wynder and Graham;Levin et al. ;Dorn; Shimkin; Haenszel et al.; Breslow et al.;Breslow; Doll;Doll and Hill;Auerbach et al.;Dunn et al.; Hammond and Horn;Hammond;Oettel;Likint;Clemmesen;Clemmesen et al.;Bradford Hill;Cornfield;Stocks;and many others(Bocker,D.,Bibliography on Smoking and Health 1958-1963;The Surgeon General's Advisory Committee on Smoking and Health,Smoking and Health,1964)).

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